

## Band Structure in N=85 Nuclei: $^{141}\text{Ba}$ and $^{139}\text{Xe}$

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A careful reanalysis of spontaneous-fission gamma data was made from our thick-source GAMMASPHERE measurements of 1995 and 2000. In particular we have used Radware least-squares peak-fitting on minimally compressed spectra (0.6667 keV per channel) to determine more accurately the transition energies and intensities with statistical standard deviations.

We propose a fourth sub-band in  $^{141}\text{Ba}$  with interlinking transitions to the earlier main band family of three sub-bands shown in our earlier paper, Zhu *et al.*<sup>1</sup>. The first of four bands could be considered as a main odd-parity band based on the lowest  $7/2^-$  with one unpaired  $f_{7/2}$  neutron. Another interlaced band represents a signature partner. A third interlaced band has even parity and represents a parity doublet band. The new fourth band fits a picture as even parity, the signature partner of the other even-parity band, although the parity of this new band is not proved. Indeed, the even parity assignment requires that the new band decays out by an M2 transition in competition with E1 and M1 transitions. An isotone,  $^{145}\text{Nd}$ , also exhibits an M2 transition in competition with E1 transitions, so this unusual M2 may be correct.

Assuming even parity for the new band allows comparing reduced transition ratios  $B(E1)/B(E2)$  among the four bands. The two ratios involving the new band fall within the range of the three ratios involving the earlier known bands. These ratios are somewhat less but comparable to the corresponding ratios in  $^{145}\text{Ba}$ .

Theoretical analysis and interpretation of the odd-A, 85-neutron isotones is quite difficult, since they are in an intermediate region too close to the closed shell of 82 neutrons to establish stable deformations, yet far enough from doubly-magic  $^{132}\text{Sn}$  to make spherical shell-model interpretations difficult.

Fission, like heavy-ion fusion-evaporation reactions, mainly populates the yrast and near-yrast levels. The band structures of the 85-neutron isotones show spacings that are roughly constant, rather than the increasing spacing characteristic of regular rotational bands. Thus, it seems more appropriate to interpret the bands in terms of couplings of the three valence neutrons to phonons generated mostly by the four or six valence protons. For seniority-1 states with a single unpaired neutron, the extra neutron pair is expected to play a role in the make-up of phonons. Not only will there be collectivity in the E2 phonons, but we may also expect collectivity in E3 and perhaps even in M2. These odd-parity phonons can be built up of coherent proton promotions from  $g_{7/2}$  or  $d_{5/2}$  orbitals to  $h_{11/2}$ , while the neutron promotions from  $f_{7/2}$  and  $h_{9/2}$  orbitals to  $i_{13/2}$  can also contribute.

The question of E1 enhancement is more complex, since it arises from the difference between neutrons and protons in the collective modes. That is, there must be separation of the center-of-charge and center-of-mass for the collective motion to contribute to E1 strength.

There are many similarities among the 85-neutron isotones, allowing correlation diagrams of band heads like those presented by Urban *et al.*<sup>2</sup> for the Nd, Sm, and Gd isotones. We have extended their correlations to Ba and Xe.

### Footnotes and References

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1. Zhu, S.J., *et al.* J. Phys. G **23**, L77 (1997)
2. Urban, W., *et al.* Phys. Rev. C **53**, 2516 (1996)